REMOTE CONTROL SYSTEM FOR CONTROLLING APPARATUS IN RESPONSE TO A VARIABLE

This invention concerns the remote control of apparatus, especially but not exclusively for reducing power consumed thereby.

Apparatus such as electric heaters and lights consumes power when it is on, and everybody knows that power (and its cost) can be saved by switching such apparatus off when it is not needed. Unfortunately, for both environmental and economic concerns, this is not always done. People forget to switch lights off, for instance, or they cannot be bothered, or it is simply too troublesome. Heaters usually include some kind of thermostatic control, but this may well be set unduly high, and in the case of an electric heater the thermostat conventionally responds to temperature *at* the heater, rather than to ambient temperature.

It is therefore a first object of the present invention to provide a control system for apparatus such as heaters and lights which controls the output of the apparatus automatically in response to ambient temperature or light level or some other variable.

It is known to provide in buildings such as hotels, factories and shopping malls management systems in which control signals from a variety of sensors are used to control lights, heaters and other apparatus. Conventionally, however, the connections between the sensors and the controllers are hard-wired, which means that such building management systems (often called BMS systems) lack flexibility and are expensive (not least in redecoration) whenever some change of layout is required.

It is therefore a second object of the present invention to provide a control system such as a building management system in which the control signals are transmitted from sensor to controller by radio.

Thus according to the invention there is provided a control system for controlling apparatus remotely in response to a variable which is independent of the system and has a changing value, which system comprises a sensor to sense the value of the variable, a radio transmitter associated with the sensor and operative to transmit a control signal representative of the sensed value of the variable, a radio receiver associated with the controlled apparatus and operative to receive the control signal, and a controller operative automatically by receipt of the control signal to control the apparatus according to the value of the variable.

The variable may be, for instance, ambient light or temperature or some other variable arising or created outside of the system, such as the presence or absence of persons in a building.

Preferably the controller is operative to change a parameter of the apparatus as the value of the variable changes, eg in proportion thereto.

The parameter may be changed in direct relation to the value of the variable. However there are many applications of the present invention in which it is beneficial rather to change the parameter in inverse relation to the value of the natural variable: thus, for instance, output from lamps may be increased automatically as ambient light value falls, or output from heaters may be increased automatically as ambient temperature falls. Alternatively the sensor may sense the presence of a person and the system arranged to switch the apparatus on, or increase the output from the apparatus, when the

presence of a person is detected. And this arrangement may include a timer operative to switch the lamps off, or reduce the light output from the lamp, a predetermined period after the time when the presence of a person is last sensed.

Whilst the parameter might be changed continuously, we have found that in practice it is sufficient – and more easily implemented – if the parameter is changed in a plurality of steps.

The control signals are preferably radio signals in the 868 MHz band.

The control system preferably includes a plurality of sensors and controllers. Also, the controllers may be operative in response to control signals from more than one sensor; for instance controllers may switch the controlled apparatus on, or increase its output, in response to a control signal from one said sensor and switch the controlled apparatus off, or decrease its output, in response to a control signal from another said sensor.

The invention will now be described by way of example only with reference to the accompanying schematic drawing, in which –

Figure 1 shows a diagrammatic plan view of an office with central heating radiators controlled automatically by means of the invention;

Figure 2 shows a schematic block diagram of a control system for controlling fluorescent light fittings according to the invention; and

Figure 3 is a diagrammatic side elevation of a corridor equipped with a person-detecting sensor arranged to control lighting in the corridor.

Referring first to *Figure 1*, this shows a floor of a hotel indicated generally at **110** and comprising a plurality of rooms **112** each provided with a radiator **114** of a central heating system (not otherwise detailed, for

simplicity of illustration) whereby the rooms **112** are heated. The hotel **110** has an entrance lobby **116** furnished in the usual way with a reception desk **118**. Behind the desk **118**, and therefore out of the way of guests, is a radio transmitter **120** operatively associated with a temperature sensor **122**. The transmitter operates in the 868 MHz band.

Each of the radiators **114** is adjustable by means of an opening and closing valve **114a**, in the usual way save that each valve is operated by a 0-10V dc stepper motor **114b**. The stepper motors **114b** are themselves controlled by radio receivers **114c** in direct radio communication with the transmitter **120**. If there is a fall in the temperature detected by the sensor **122**, the transmitter **120** transmits to the receivers **114c** a signal representative of the lower temperature, and this causes the stepper motors **114b** to turn the radiator valves **114a** towards (or further towards) their open position. Similarly, if there is a rise in the temperature detected by the sensor **122**, the transmitter **120** transmits to the receivers **114c** a signal representative of the higher temperature, and this causes the stepper motors **114b** to turn the radiator valves **114a** towards (or further towards) their closed position. Thus the heat output of the radiators **114** is varied in inverse relation to the sensed temperature.

The signal from the transmitter **120** may be an analogue representation of the sensed temperature, but in many cases it is sufficient and more convenient for the signal to be a step-wise approximation of the temperature.

Figure 2 illustrates another use of the invention. It shows two remotely controlled fluorescent light fittings indicated in broken lines at **210** and **212**.

(As indicated in *Figure 2*, there may be more light fittings similarly controlled). The two fittings **210** and **212** are of different sizes, fitting **210** comprising a single controllable tube (not detailed) and fitting **212** comprising two individually controllable tubes. The light outputs of the tubes are varied by means of 0-10V dimming ballasts **214** of well known form, which ballasts are operatively connected to radio receivers **216**. The light fittings **210** and **212** are powered from live L and neutral N mains supply lines, the live L line including a switch **218** providing overall control.

Provided the switch **218** is closed to complete the live L supply, the light fittings **210** and **212** are remotely controlled as will now be described in more detail. A photometer **220** is arranged, remote from the light fittings **210** and **212**, in such a position as to detect ambient light. A radio transmitter **222** communicating directly with the receivers **216** in the 868 MHz band is connected to the photometer **220** and transmits to the receivers **216** control signals representative of the light level detected by the photometer **220**. If there is a fall in the ambient light level as detected by the photometer **220**, the transmitter **222** transmits to the receivers **216** a signal representative of the lower light level, and this causes the dimming ballasts **214** to increase the light output from the fittings **210** and **212**. Similarly, if there is a rise in the light level detected by the photometer **220**, the transmitter **222** transmits to the receivers **216** a signal representative of the higher ambient light level temperature, and this causes the dimming ballasts **214** to decrease the light output from the fittings **210** and **212**. Thus the light output of the fittings **210** and **212** is varied in inverse relation to the ambient light level.

The signal from the transmitter **222** may be an analogue representation of the ambient light level, but in practice step-wise adjustment over say **100** or more steps makes adjustment of the light output imperceptible to users.

Figure 3 illustrates another use of the invention. It shows a corridor **310** equipped with two overhead lights **312**. Prior to the introduction of the invention in this corridor **310**, the lights **312** were operated manually from either of two wall switches located at opposite ends of the corridor **310**. But despite the apparent convenience of this arrangement the lights **312** were often left on. Now, by means of the invention, the lights **312** operate automatically under the control of a passive infra-red detector **314** arranged to detect any person in the corridor **310**. When this happens, a radio transmitter **316** associated with the detector **314** transmits a control signal. This control signal is received by receivers **318** associated with the lights **312** and causes a switch in the power supply to be closed automatically, switching the lights **312** on. Thus the lights **312** are switched on automatically, but only when needed. Thus power is saved.

A particular advantage of the arrangement of *Figure 3* is that the lights **312** are provided with automatic operation without the expense of rewiring or redecoration, since the detector **314** can be located for best visibility without concern for the location of the lights **312** and the wire-free arrangement can be installed without damage to the existing fabric.

A photometer **320** associated with another radio transmitter **322** sends control signals to the receivers **318** such that the lights **312** are not switched on if the ambient light level is sensed to be adequate. Thus control signals

from the transmitter **322** can override those from the transmitter **316**. Those skilled in the science will appreciate that the photometer **320** and its associated transmitter **322** may also be arranged to set the output of the lights **312**, when switched on from the passive infra-red detector **314**.

Further, a timer **324**, which may conveniently be located outside the corridor **310** and may be part of a building management system (not detailed), is associated with a further radio transmitter **326**. This is also arranged to send control signals to the receivers **318**. The arrangement is such that the lights **312** are switched off, or their output reduced, if the passive infra-red detector **314** fails to detect the presence of a person in the corridor **310** for some predetermined period.

It is to be understood that heaters or other apparatus may be controlled in similar fashion to the lights **312**, ie so that one sensor turns them on or up and another sensor turns them off or down. Other modifications will be apparent to those skilled in the science.